Fermi National Accelerator Laboratory

New Evidence for Rapidity Gaps Between Jets and Diffractive W and Dijet Production at CDF

K. Goulianos
Representing the CDF Collaboration

Rockefeller University
1230 York Avenue
New York 10021

Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510

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NEW EVIDENCE FOR RAPIDITY GAPS BETWEEN JETS AND DIFFRACTIVE W AND DIJET PRODUCTION AT CDF

K. GOULIANOS[a]

The Rockefeller University, 1230 York Avenue
New York, NY 10021, USA
(Representing the CDF Collaboration)

We present new evidence for events with a central rapidity gap between jets. and new results on diffractive W and dijet production in pp collisions at $\sqrt{s}$=1.8 TeV.

We report new evidence for dijet events with a central rapidity gap (RG) between jets and results on diffractrive (tagged by a forward RG) W and dijet production in $p\bar{p}$ collisions at $\sqrt{s}$=1.8 TeV. The data were collected in Tevatron runs 1A (1992-93) and 1B (1993-95) with disabled beam-beam counters, to eliminate biasing against forward RGs, and an added forward dijet trigger selecting $E_T^{jet} > 20$ GeV and $|\eta^{jet}| > 1.8$. The results presented were obtained from 9492 (29496) dijets with $\eta_1\eta_2 > 1$ ($\eta_1\eta_2 < 1$), and 8246 (4593) $W \to e\nu(\mu\nu)$ events with a central $e^\pm$ ($|\eta| < 1.1$) or $\mu^\pm$ ($|\eta| < 0.6$).

The relevant CDF detector componets are the central tracking chamber ($|\eta| < 1.2$) and the calorimeters: central ($|\eta| < 1.1$; $\Delta\eta \times \Delta\phi = 0.1 \times 15^0$), plug ($1.1 < |\eta| < 2.4$; 0.1×5^0) and forward ($2.4 < |\eta| < 4.2$; 0.1×5^0).

In a given $\Delta\eta$ RGs from color singlet exchange (CSE) appear as an *excess* over RGs from normal fluctuations in the underlying event multiplicity. In the dijet case, rather than using Monte Carlo simulations and/or fits to evaluate the excess, we determine it by comparing the multiplicity distribution with a template obtained from another process that is not expected to have CSE RGs. For opposite side (OS) dijets, $\eta_1\eta_2 < 0$, we use as a template the same side (SS) dijet distribution; for SS dijets, we use W events, which have a relatively small amount of CSE RGs, as determined by an independent analysis based on lepton-gap correlations. The template method has the added advantage of eliminating detector related systematic uncertainties.

In our search for CSE RGs, a "particle" is defined as a track of $P_T > 300$ MeV or a tower of E_T(corrected)> 300 MeV or $E > 1.5$ GeV (in W case).

In Fig. 1 we compare the track (left) and tower (right) OS (solid) multiplicity within $|\eta| < 1.0$ with the (normalized) SS distribution (dashed) for $|\eta| < 1.2$. The asymmetry is defined as $A = (N_{OS} - N_{SS})/(N_{OS} + N_{SS})$. The excess OS events in the $N_{track} = 0$ and $N_{tower} = 0, 1, 2$ bins are attributed to CSE. The spreading of the tower signal into the N=1,2 bins is presumably

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due to calorimeter noise or due to γs coming from decays of neutral particles at $|\eta| > 1$. The ratio of excess RG to all events is

$$R_{track} = [2.07 \pm 0.24(stat)]\% \qquad R_{tower} = [2.03 \pm 0.24(stat)]\%$$

The average $R = [2.05 \pm 0.24]\%$ is larger than the CDF [1] and D$\emptyset$[2] values of $R_{CDF}[0.85 \pm 0.12(stat)^{+0.24}_{-0.12}(syst)]\%$ & $R_{D0}[1.07 \pm 0.10(stat)^{+0.25}_{-0.13}(syst)]\%$ We are currently investigating the dependence of the signal on $|\eta^{\ell t 1} - \eta^{\ell t 2}|$.

In the W sample we look for RGs within $2.4 < |\eta| < 4.2$. Because of the boosted cms, and the large W mass requiring *valence* quarks from the p or $\bar{p}$ to interact with the flavor symmetric pomeron, diffraction favors the (angle$\otimes$charge)-gap correlated topology of $\eta_l \times C_l > 0$ with $\eta_l \times \eta_{gap} < 0$ over the anticorrelated, $\eta_l \times C_l > 0$ with $\eta_l \times \eta_{gap} > 0$, where C_l is the sign of the charge of the lepton. Fig. 2(*left*) shows the correlated and anticorrelated multiplicities and their asymmetry. From the excess in the zero bin, and assuming a hard-quark pomeron structure of the form $G(\beta) \sim \beta(1-\beta)$ in calculating the acceptance (where β is the momentum fraction of the parton in the pomeron), we find that the fraction of diffractive to non-diffractive (ND) W production is

$$R_W = [2.0 \pm 1.9(stat \oplus syst)]\%$$

The standard (renormalized) pomeron flux POMPYT prediction [3] for a hard 3-flavor quark pomeron is $\sim 16\%(1.8\%)$.

In searching for diffractive dijets, we look for an excess zero bin multiplicity in $2.4 < |\eta| < 4.2$ opposite the dijets using Ws as a template with two entries per event, one for each η-side, to reduce diffractive W RGs down to $\sim (0.2 \pm 0.2)\%$. Fig. 2(*right*) shows the SS dijet and W distributions and their asymmetry. From the excess in the zero bin we derive the diffractive to ND ratio $R = (0.46 \pm 0.09)\%$. Correcting for acceptance (assuming a hard pomeron structure), for calorimeter noise and for a possible RG signal in the W sample, and including systematic uncertainties, we obtain the (preliminary) ratio

$$R_{JJ} = [0.8 \pm 0.3(stat \oplus syst)]\%$$

The standard and renormalized pomeron flux POMPYT predictions [3] for a hard gluon (quark) pomeron structure are $\sim 5\%$ (2%) and $\sim 0.56\%(0.22\%)$.

References

1. F. Abe *et al.*, CDF Collaboration, Phys. Rev. Lett. **74** (1995) 855.
2. S. Abachi *et al.*, D0 Collaboration, Phys. Rev. Lett. **76** (1996) 734.
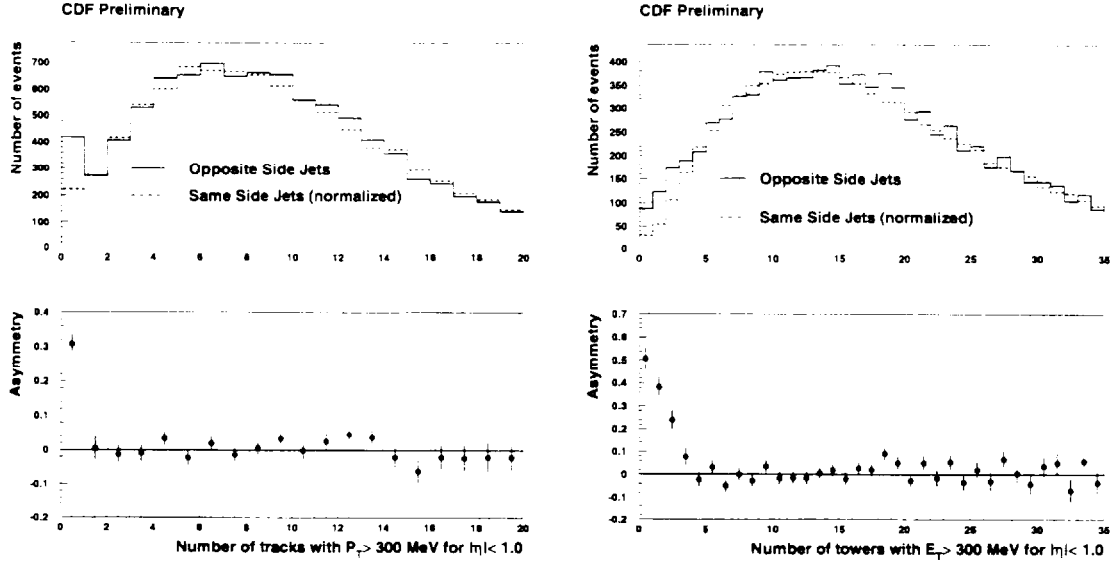3. K. Goulianos, Phys. Letters **B358** (1995) 379.

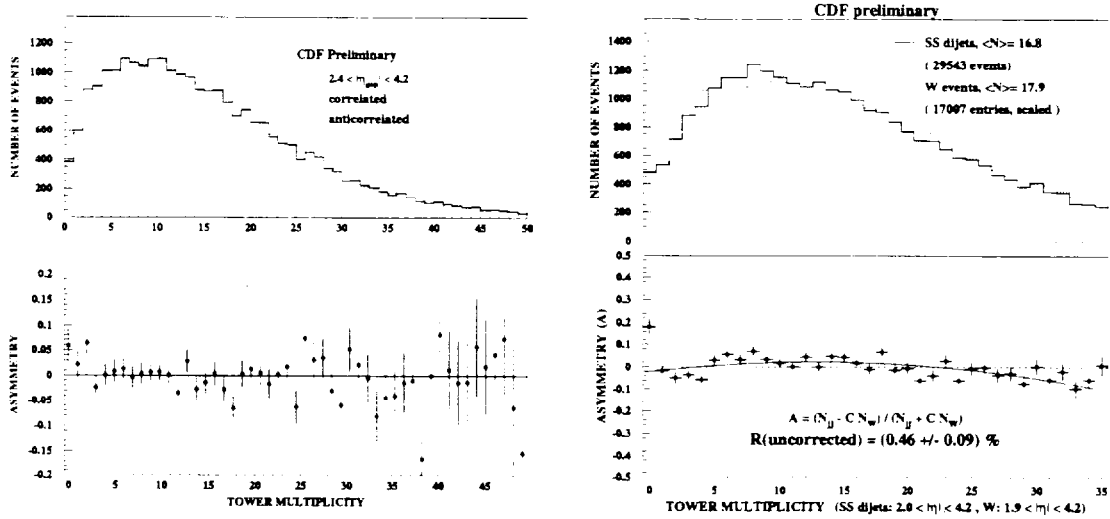Figure 1: Dijet track (left) and tower (right) multiplicities.

Figure 2: Multiplicity distributions within $2.4 < |\eta| < 4.2$: (*left*) for W events; (*right*) for SS dijet events compared to that of W events.

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